PATENT SPECIFICATION

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Complete Specification Accepted: Feb. 23, 1940.

PROVISIONAL SPECIFICATION

Improvements in or relating to Electric Motors

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, and HENRY CHARLES EDWARD JACOBY, of The General Electric Company Limited, Engineering Works, Witton, Birmingham, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to electric motors having cores of magnetic material carrying conducting elements and particularly, but not exclusively, to alternating electric current motors of the self-starting synchronous type provided with a rotor having a squirrel cage winding. Previously, in self-starting synchronous motors of this type, and having a laminated rotor core, the core laminations were cut away in places corresponding to the stator poles so that some of the squirrel cage bars passed through the laminations in the usual manner whilst other bars passed through the cut away portions of the core laminations and were not, therefore, surrounded by magnetic material. Such motors, however, have certain disadvantages with regard to characteristics since firstly they have a rather uneven starting torque and secondly they possess a poor synchronising torque. One object of the present invention, therefore, is the provision of a self-starting synchronous alternating electric current motor provided with a rotor having a squirrel cage rotor winding which has a better and more even starting torque and a better synchronising torque. Another object is to provide a motor of this type in which a required characteristic may be simply and readily obtained.

According to a feature of the present invention, in an electric motor having a core of magnetic material carrying conducting elements, the radially outer part of a conducting element is closely surrounded by magnetic material of the core whilst the radially inner part of the element is spaced from the magnetic material of the core.

According to another feature of the invention, in an electric motor having a rotor core of magnetic material carrying conducting rotor elements, the radially outer part of a conducting rotor element passes through magnetic material of the core whilst the radially inner part of the element passes through air or other non-magnetic material over the whole or a portion of its length.

According to a further feature of the invention, in an alternating electric current motor having a squirrel cage winding disposed within a rotor core of magnetic material, two or more adjacent bars have their radially outer parts bridged by magnetic material of the core and their radially inner parts separated by air or other non-magnetic material over the whole or a portion of their lengths.

If desired, the core may be laminated and the rotor core of a motor may comprise at least two different types of laminations, variation in the relative proportions of which is adapted to provide different motor characteristics.

In carrying the invention into effect, according to one example of construction, the rotor of a small self-starting synchronous alternating electric current motor comprises a squirrel cage winding carried within a laminated rotor core. The conducting bars of the squirrel cage winding, which may be of copper, are disposed in known manner adjacent to the periphery of the core and may be circular, rectangular or key-shape in cross-section. The rotor core laminations are formed with holes for the conducting bars and parts of the laminations between the holes for groups of bars corresponding to the poles of the motor are cut away towards the radially inner parts or lower parts of the bars. In this manner, the bars of each group are bridged by magnetic material at the tops or radially outer parts thereof whilst there is no magnetic material between the bottom or radially inner parts of the bars. If desired, thin strips of the laminations may support the outer bridges of magnetic material, these strips running in each lamination radially between the conducting bars from the

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main part of a lamination to the adjacent part of a bridge. These strips serve to support the bridges to some extent but if the conducting bars are key-shape in cross-section, the bars themselves act to secure the bridges against centrifugal forces.

The conducting bars may be provided with conducting end rings in known manner or, alternatively, the bars may cast integral with the end rings. In this case, the parts of the core laminations which are cut away may be filled in solid with the bars.

In another embodiment of the invention, the core comprises at least two different types of laminations, one type of known form in which holes simply for accommodating the bars are cut and another or others as described above. The different types of laminations are interleaved one with another and variation in the relative proportions of the types of plates provides differing motor characteristics. The laminations of known type serve better to support the conducting bars of the squirrel cage winding than the other laminations and also support the bridges of magnetic material. If desired, if the number of the known type of laminations required effectively to support the bars and bridges is in excess of the number required to give the required motor characteristics, plates of non-magnetic material similar in form to these laminations may be used. It will be appreciated that, by varying the number of different laminations, it is possible to adjust the relative reluctances of the cut away parts of the rotor core and the normal parts, such adjustment leading to variations in the characteristics of the motor.

In the arrangements described above, the invention is shown applied to self-starting synchronous alternating electric current motors but naturally it may be applied to other types of motors such, for example, as those employed in step by step indicators and in cases where a rotor core is required which has a higher reluctance in one axis than in another.

Dated the 22nd day of August, 1938.

For the Applicants,
W. J. C. CHAPPLE,
Chartered Patent Agent.

COMPLETE SPECIFICATION

Improvements in or relating to Electric Motors

We, THE GENERAL ELECTRIC COMPANY LIMITED, of Magnet House, Kingsway, London, W.C.2, a British company, and HENRY CHARLES EDWARD JACOBY, of The General Electric Company Limited, Engineering Works, Witton, Birmingham, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to electric motors having cores of magnetic material carrying conducting elements and particularly, but not exclusively, to alternating electric current motors of the self-starting synchronous type provided with a rotor having a squirrel cage winding. Previously, in self-starting synchronous motors of this type, and having a laminated rotor core, the core laminations were cut away in places corresponding to the stator poles so that some of the squirrel cage bars passed through the laminations in the usual manner whilst other bars passed through the cut away portions of the core laminations and were not, therefore, surrounded by magnetic material. Such motors, however, have certain disadvantages with regard to characteristics, since firstly they have a rather uneven starting torque and secondly they possess a poor synchronising torque. One object of the present invention, therefore, is the provision of a self-starting synchronous alternating electric current motor provided with a rotor having a squirrel cage rotor winding which has a better and more even starting torque and a better synchronising torque. Another object is to provide a motor of this type in which a required characteristic may be simply and readily obtained.

According to a feature of the present invention, in a squirrel cage rotor for an electric motor, groups of bars of the squirrel cage winding have their radially outer parts bridged and partly surrounded by magnetic material of the core of the rotor whilst their radially inner parts pass in part or wholly through air or other non-magnetic material.

According to another feature of the invention, in an electric motor having a rotor core of magnetic material carrying conducting rotor elements, two or more adjacent elements have their radially outer parts bridged by magnetic material of the core and their radially inner parts separated by air or other non-magnetic material over the whole or a portion of their length.

According to a further feature of the invention, in an alternating electric

current motor having a squirrel cage winding disposed within a rotor core of magnetic material, two or more adjacent bars have their radially outer parts bridged by magnetic material of the core and their radially inner parts separated by air or other non-magnetic material over the whole or a portion of their lengths.

Preferably, the core is laminated and the rotor core of a motor may comprise at least two different types of laminations, variation in the relative proportions of which is adapted to provide different motor characteristics.

Several constructions of rotors for small self-starting synchronous alternating current electric motors will now be described by way of example with reference to the figures of the accompanying drawing. Each figure shows a cross-section through a rotor at right angles to the axis thereof and each rotor comprises a squirrel cage winding carried within a laminated rotor core.

Referring now to the drawings, more particularly Figures 1—6 thereof, each rotor comprises a laminated core 1 having a central aperture 2 through which a rotor spindle (not shown) is arranged to pass and a squirrel cage winding of conducting bars 3. The conducting bars 3 of a squirrel cage winding, which bars 3 may be of copper, are disposed in known manner adjacent to the periphery of the core 1 and may be circular in cross-section as shown in Figures 1, 3 and 4, rectangular in cross-section as shown in Figure 2 and 6, or key-shape in cross-section as shown in Figures 5 and 6. The rotor core laminations are formed with holes for the conducting bars 3 and parts of the laminations between the holes for groups of bars 3 corresponding to the poles of the motor, two in the arrangements being described, are cut away towards the radially inner parts or lower parts of the bars 3 to form gaps 4 in the arrangements shown in Figures 1—5. In this manner, the bars 3 of each group are bridged by magnetic material at the tops or radially outer parts thereof whilst there is no magnetic material between the bottom or radially inner parts of the bars 3. If desired, and as shown in Figure 3, thin strips 5 of the laminations may support the outer bridges 6 of magnetic material, these strips 5 running in each lamination radially between the conducting bars 3 from the main part of a lamination to the adjacent part of a bridge 6. These strips 5 serve to support the bridges 6 to some extent but if, as shown in Figures 5 and 6, the conducting bars 3 are key-shape in cross-section, the bars themselves act to secure the bridges 6 against centrifugal forces.

The conducting bars 3 may be provided with conducting end rings (not shown) in known manner or, alternatively, the bars 3 may cast integral with the end rings. In this case, the parts of the core laminations which are cut away may be filled in solid with the bars 3 as shown in Figure 6.

The core 1 of a rotor may comprise at least two different types of laminations, one type of the known form shown in Figure 7 in which holes simply for accommodating the bars 3 are cut and another or others as described above. The different types of laminations would be interleaved one with another and variation in the relative proportions of the types of laminations provides differing motor characteristics. The laminations of known type serve better to support the conducting bars 3 of a squirrel cage winding than the other laminations and also support the bridges 6 of magnetic material. If the number of the known type of laminations required effectively to support the bars 3 and bridges 6 is in excess of the number required to give the required motor characteristics, plates of non-magnetic material similar in form to these laminations may be used. It will be appreciated that, by varying the number of different laminations, it is possible to adjust the relative reluctances of the cut away parts of the rotor core and the normal parts, such adjustment leading to variations in the characteristics of the motor.

In the arrangements described above, the invention is applied to self-starting synchronous alternating electric current motors but naturally it may be applied to other types of motors such, for example, as those employed in step by step indicators and in cases where a rotor core is required which has a higher reluctance in one axis than in another.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An electric motor having a rotor core of magnetic material carrying conducting rotor elements, wherein two or more adjacent elements have their radially outer parts bridged by magnetic material of the core and their radially inner parts separated by air or other non-magnetic material over the whole or a portion of their lengths.

2. An alternating electric current motor having a squirrel cage winding disposed within a rotor core of magnetic material, wherein two or more adjacent bars have their radially outer parts

bridged by magnetic material of the core and their radially inner parts separated by air or other non-magnetic material over the whole or a portion of their lengths.

3. An electric motor as claimed in Claim 1 or Claim 2, wherein the core is laminated.

4. An electric motor as claimed in Claim 3, wherein the rotor core comprises at least two different types of laminations, variation in the relative proportions of which is adapted to provide different motor characteristics.

5. A squirrel cage rotor for an electric motor, wherein groups of bars of the squirrel cage winding have their radially outer parts bridged and partly surrounded by magnetic material of the core of the rotor whilst their radially inner parts pass in part or wholly through air or other non-magnetic material.

6. A synchronous alternating current electric motor having a squirrel cage rotor substantially as hereinbefore described with reference to the accompanying drawings.

7. A squirrel cage rotor for a synchronous alternating current motor substantially as hereinbefore described with reference to the accompanying drawings.

Dated the 7th day of July, 1939.

For the Applicants,
W. J. C. CHAPPLE,
Chartered Patent Agent.

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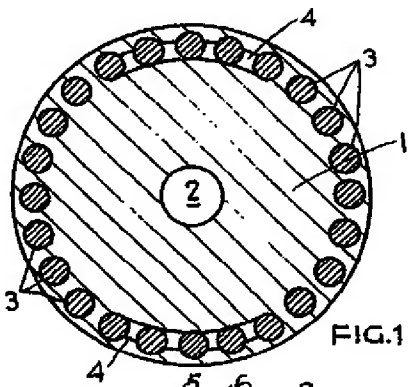

FIG.1

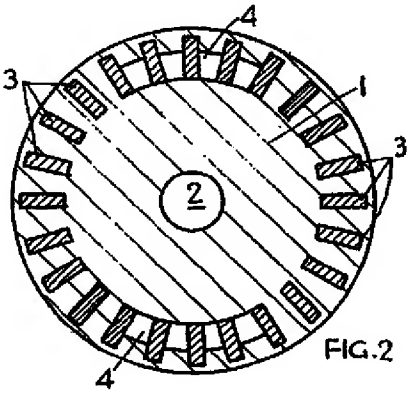

FIG.2

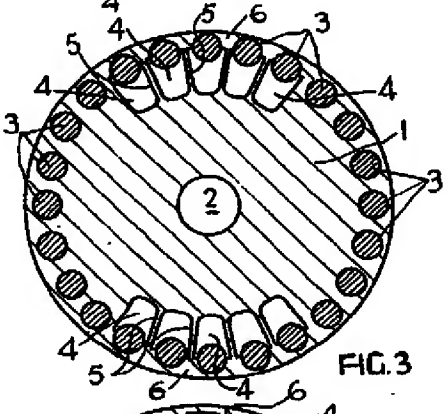

FIG.3

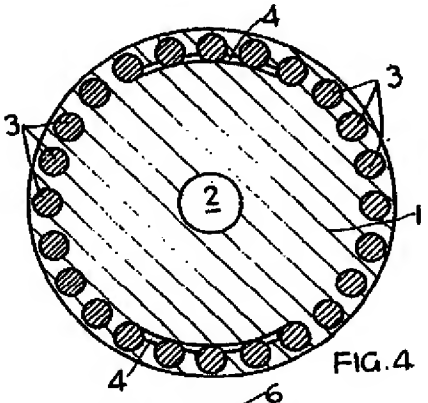

FIG.4

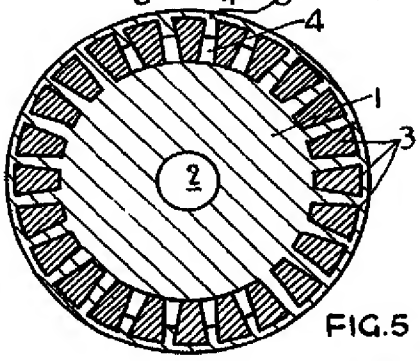

FIG.5

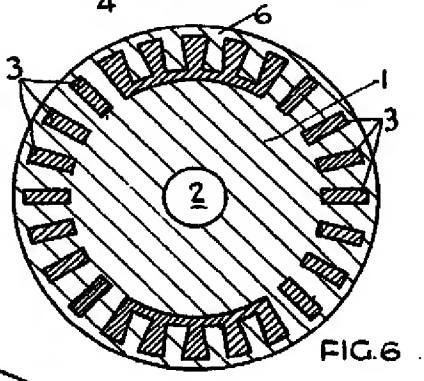

FIG.6

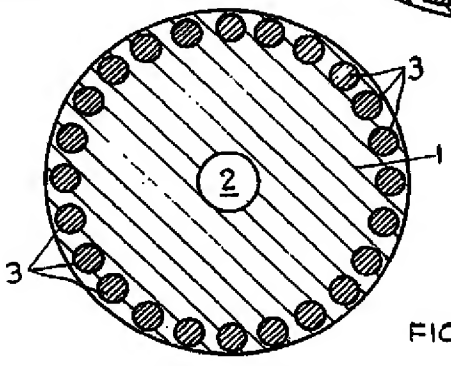

FIG.7

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